neoBLUE™ LED Phototherapy System

Service Manual

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Chapter 1 Introduction

In this chapter:

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1.1 About this manual

1.1.1 Overview

This manual contains information needed for servicing the neoBLUE Phototherapy System.

- Description of the product and overview illustrations (Chapter 1)
- Maintenance procedures (Chapter 2)
- Troubleshooting guide (Chapter 3)
- Repair procedures (Chapter 4)
- Parts and ordering information. (Chapter 5)
- Conversion chart for photometers of various brands. (Chapter 6)
- Index

1.1.2 Intended users

This service manual is written for qualified biomedical technicians. It describes service tasks which could lead to injury, or which could damage the device, if attempted by a person without the requisite skills.

1.1.3 Manual conventions

Precautionary information is emphasized by being labeled as warning, caution or important. Other explanatory information is highlighted with the word **Note**.

Type of information	Usage
WARNING	Identifies conditions or practices that may result in injury or death to the patient and/or user. Warnings are boxed and preceded by a hazard symbol.
CAUTION:	Precedes an action that may result in damage to or malfunction of the device.
Important!	An instruction provided to help ensure correct clinical results and provide quality assurance to the phototherapy procedures.
Note:	Background information provided to clarify a particular step or procedure. Information in this category is not considered precautionary.

Throughout the manual, when parts are referred to in figures or in the text, the Item Number from the Parts List (Chapter 5) is used to identify the part.

1.2 Product description

The neoBLUE LED Phototherapy System consists of two products – the neoBLUE Phototherapy light source (light) and the neoBLUE Phototherapy Roll Stand (roll stand). These components provide a floor-standing, mobile, phototherapy light that delivers a narrow band of high-intensity

blue light via blue light emitting diodes (LEDs) to provide treatment for neonatal hyperbilirubinemia.

Blue LEDs emit light in the range of 400 – 550 nm (peak wavelength 450-475 nm). There are two light intensity settings, high and low. The light output is optimized to provide an average intensity of 30-35 µW/cm2/nm at the high setting and 12-15 µW/cm2/nm at the low setting at 30 cm (12 inches) distance from the light enclosure.

WARNING **Eye Protection:** Do not look directly into the LEDs. Some people are sensitive to blue light in the environment. Amber safety glasses shield sensitive eyes, minimizing the effects of the blue light.

LEDs have minimal light output degradation over their lifetime with proper use. Nevertheless, the technician can adjust the output of the LEDs using two potentiometers located on the side of the light enclosure. The light is expected to operate as specified at least 10,000 hours at the low setting, and at least 4,000 hours at the high setting.

The roll stand is designed to hold 8 lbs of weight with a base designed to accommodate the weight distribution of the light enclosure at any height or angle.

WARNING If an alternative stand is used, care must be taken to validate the load capacity.

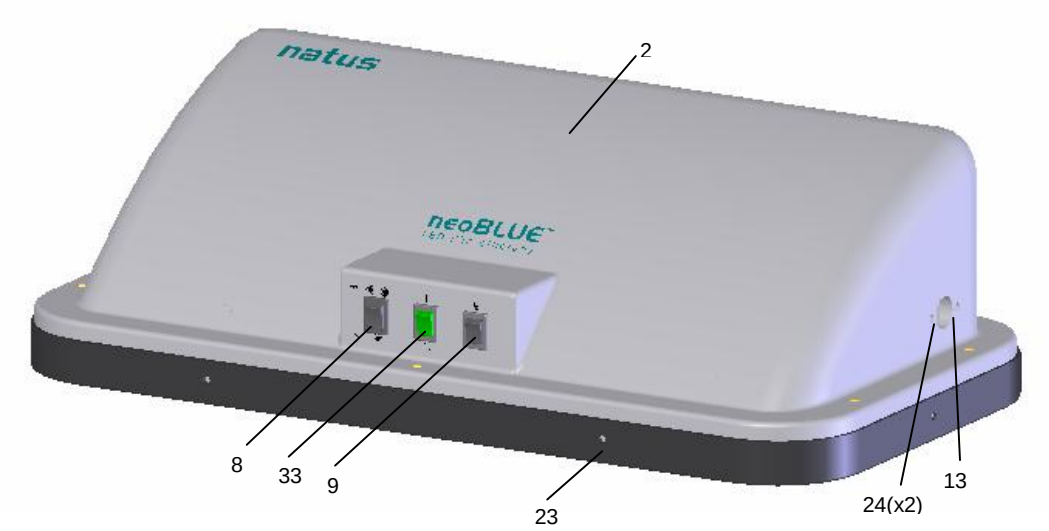
The light is mains-power operated. The power cord plugs into a receptacle at the power inlet at the back of the light enclosure. A power cord strain relief bracket is provided to hold the power cord in place.

1.3 Pictorial introduction to the neoBLUE system

This section is meant to acquaint you with the various views of the neoBLUE light that you will see in the course of troubleshooting and repairing it. The item numbers and names used in the Parts List (see Chapter 5) are used throughout the book whenever parts are discussed.

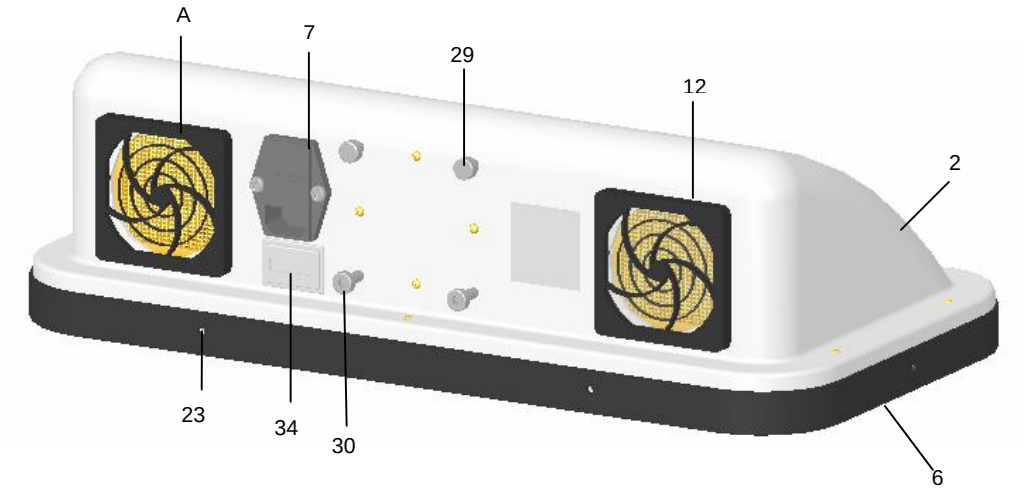
These pictures show the front and rear views of the light enclosure, and internal views showing where the major components are located and some details. Also included is a block diagram.

FIGURE 1-1 EXTERNAL, FRONT VIEW



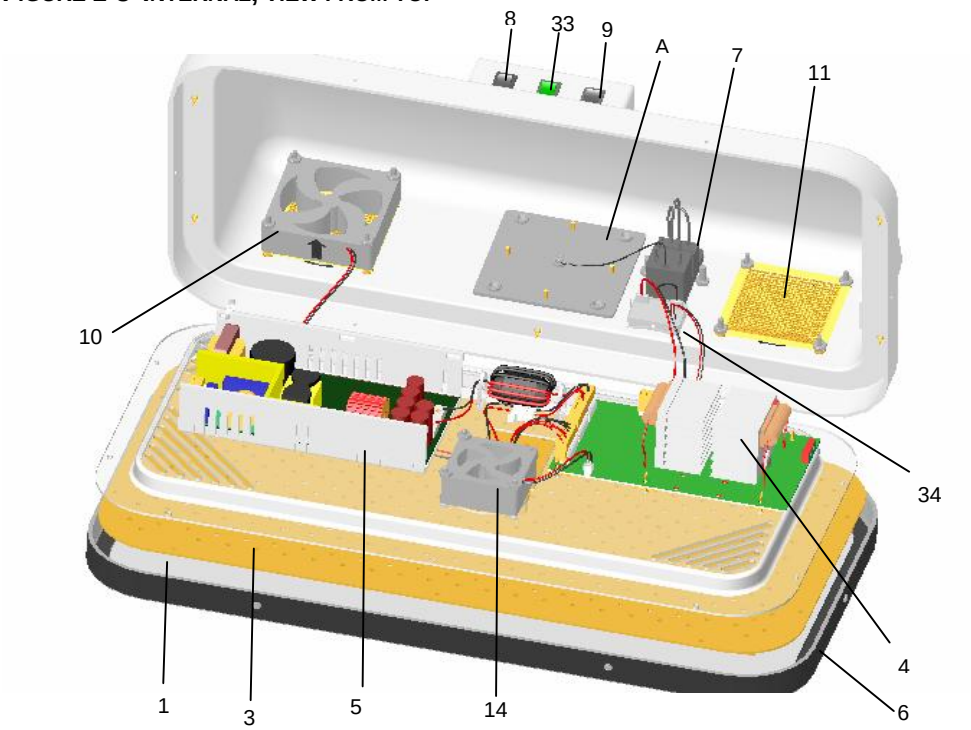
Item	Description	Notes
2	Enclosure	
8	Light intensity rocker switch	Sets intensity to high or low
9	Target light rocker switch	Controls red target light; momentary action
13	Calibration access cover	Covers potentiometers for adjusting light intensity
23	Self tapping screw	
24	Screw, 5/8″	
33	On/standby switch	Lights up when device is on

FIGURE 1-2 EXTERNAL, REAR VIEW



Item	Description	Notes
2	Enclosure	
6	Diffuser	Diffuses the light from the LEDs
7	AC power entry module	Includes fuses
12	Enclosure fan filter assembly	Consists of a cover, filter, and backplate
23	Self tapping screw	Location for power cord strain relief bracket
29	Thumbscrew	For attaching enclosure to roll stand
30	Locating post screw	Slotted
A	Air vent	Consists of an enclosure fan filter assembly without a filter
34	Timer	Counts hours device is on

FIGURE 1-3 INTERNAL, VIEW FROM TOP

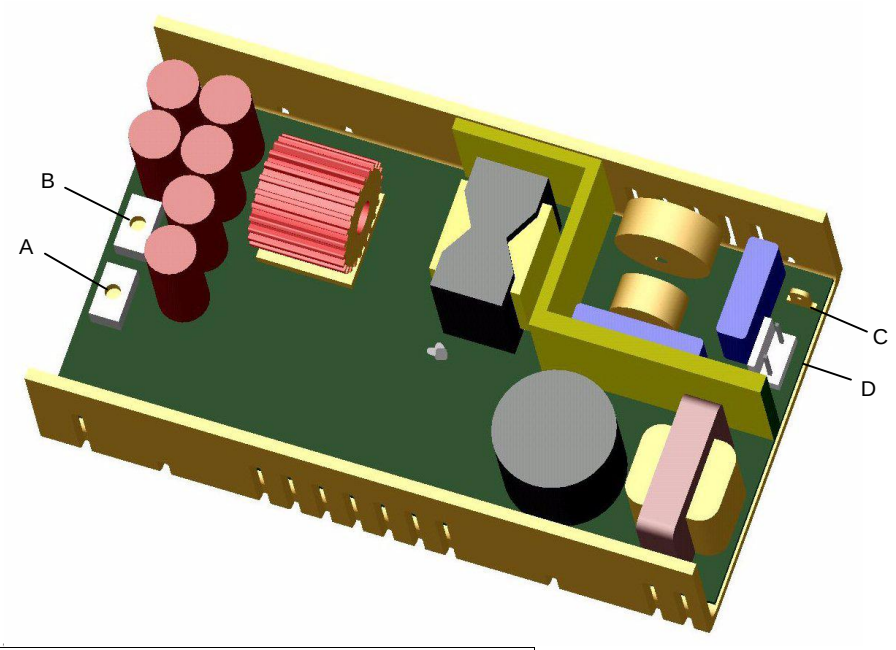


Item	Description	Notes
1	LED light panel	
3	Subplate	Holds power supply, assembly, and subplate fan
4	LED light current assembly	
5	Power supply	
6	Diffuser	Diffuses the light from the LEDs
7	AC power entry module	Includes fuses
8	Light intensity rocker switch	For selecting intensity level
9	Target light rocker switch	Indicates center of treatment area
10	Enclosure fan	Cools the enclosure

(continued on next page)

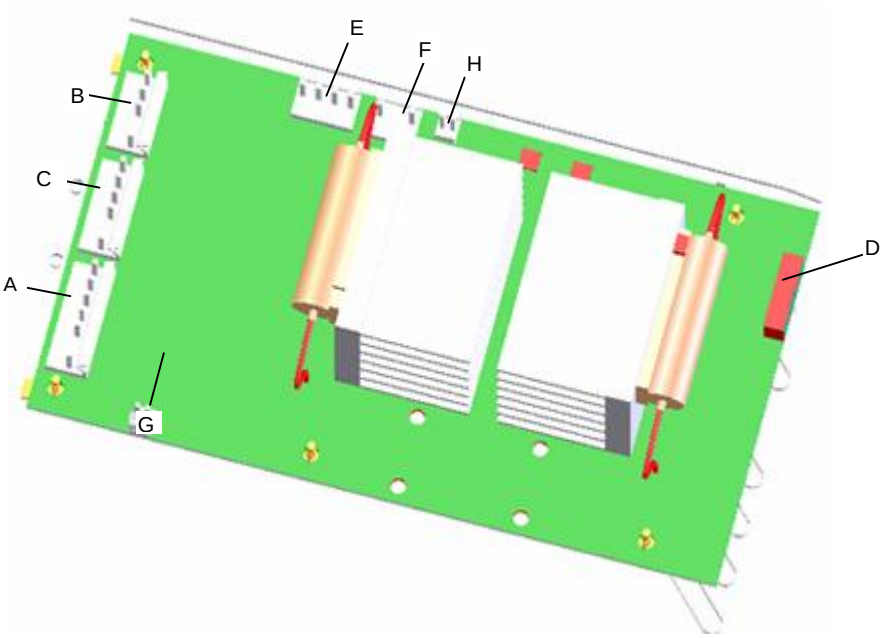
Item	Description	Notes
		(continued from previous page; please see Figure 1-3)
11	Vent guard	
14	Subplate fan	Cools the LED light panel and diffuser
A	Mounting plate	Mounts light to roll stand
33	On/standby switch	Lights up when device is on
34	Timer	Counts the hours the device is on

FIGURE 1-4 POWER SUPPLY



Item	Description
A	24 volt ground
B	24 volts +
C	Intensity and target switch header
D	AC inlet

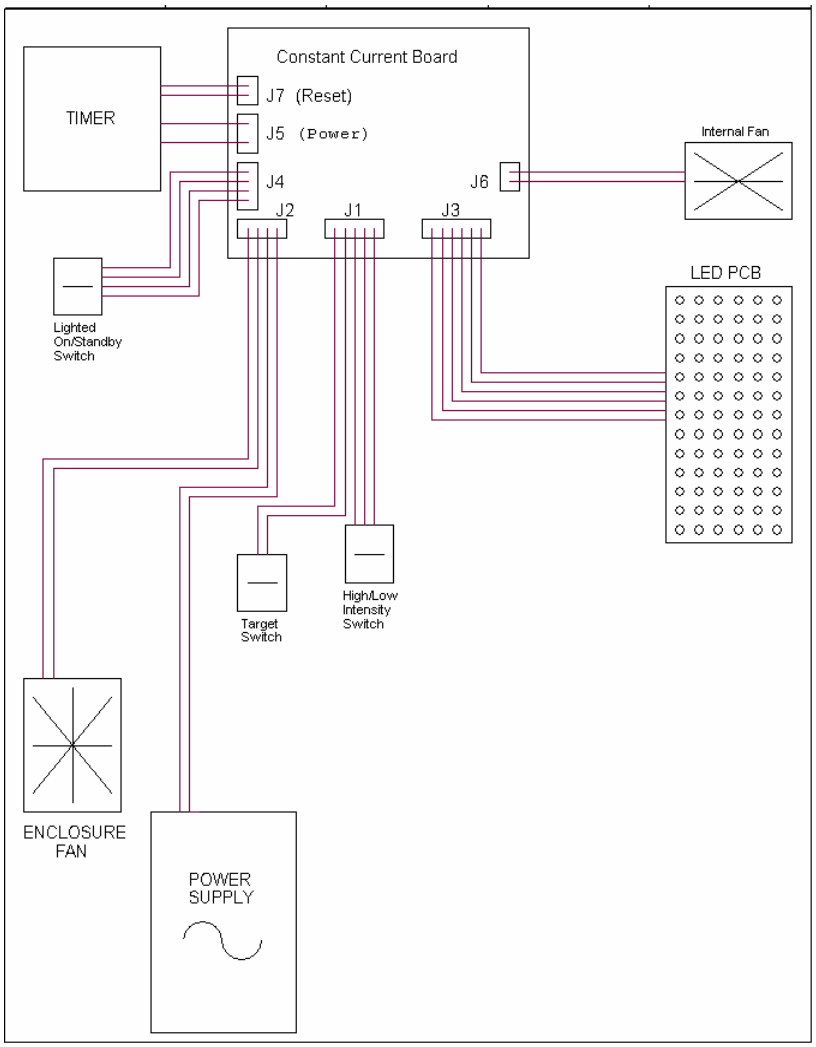
FIGURE 1-5 LED LIGHT CURRENT ASSEMBLY



Item	Description
A	LED light panel header, J1
B	Main power, fan header, J2
C	Front panel switch header, J3
D	Light intensity adjustment potentiometers
E	On/standby header, J4
F	Timer power header, J5
G	Subplate fan power header, J6
H	Timer reset header, J7

The block diagram, Figure 1-6, lays out the electrical connections.

FIGURE 1-6 BLOCK DIAGRAM



1.4 Before you start

WARNING Observe Electrostatic Discharge (ESD) precautions when handling, adjusting, or performing any procedure with the device internal components.

1.5 Contacting Natus Technical Support

Should you encounter situations that are not covered by this Service Manual, contact a Natus Technical Support representative.

Please have your Natus device model and serial number available when calling Technical Support.

United States customers: Contact a Natus Technical Service Representative at:

Telephone: (888) 496-2887
Fax: (650) 802-8680
Email: technical_service@natus.com

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Fax: +49 (0) 8989 4597 59
Email: info@fischer-zoth.de

Chapter 2 Routine Maintenance Procedures

In this chapter:

2.1	Cleaning	17
2.2	Safety testing	19
2.3	Performance Verification	20
2.4	Adjusting light intensity	24

This chapter includes procedures for routine maintenance of the neoBLUE light, hereafter called the Unit Under Test (UUT). These procedures must be performed after any of the following events and/or as prescribed by the institution's maintenance schedule:

- Initial receipt of the UUT at the institution.
- Foreign material or liquid has been deposited on the UUT.
- UUT has been visually damaged or subjected to mechanical shock (e.g., being dropped).
- UUT has been submitted for maintenance or scheduled performance verification.

2.1 Cleaning

Cleaning the UUT incorporates two different tasks:

- Cleaning the light enclosure and accessories (Section 2.1.1)
- Cleaning the light enclosure air filters (Section 2.1.2)

WARNING Disconnect UUT from AC power before cleaning.

WARNING Biohazard. Until UUT is disinfected per institutional requirements, gloves and other appropriate safeguards must be employed.

CAUTION: Do not immerse the UUT or its accessories in liquid, or clean with caustic or abrasive cleaners. Do not spray or pour any liquid on the UUT enclosure.

2.1.1 Cleaning the light enclosure and accessories

Clean the UUT enclosure using a cloth dampened with Germiocide™ or an equivalent product. Wipe the exterior plastic surfaces lightly. Do not allow any liquid to penetrate the power connector, switches, fans, connectors, or openings on the enclosure.

2.1.2 Cleaning the light enclosure air filters

The air filter should be cleaned at least every 30 days to prevent possible instrument overheating.

1 Remove the cover from the enclosure fan filter assembly, shown below in Figure 2-1.

FIGURE 2-1 LOCATING THE FILTER

2 Inspect the filter for damage. If damaged, it must be replaced.

3 Clean the filter by holding it under warm running water to clean away dust and other foreign materials.

4 Place the filter in a clean environment and allow it to air dry. The process can be expedited by having extra filters available for immediate replacement.

5 Return a dry filter to the fan assembly and press the filter cover firmly into place.

2.2 Safety testing

The safety tests meet the standards of, and are performed in accordance with, IEC 60601-1, Amendment 1, Amendment 2,) and UL 2601, for instruments as Class 1 and TYPE BF and ANSI/NFPA Standard 99.

Applicable tests for these standards are listed below. Technicians must be familiar with the standards applicable to the technician's institution and country. Test equipment and its application must comply with the applicable standard in:

- Table 2-1 Ground Integrity
- Table 2-2 Earth leakage current
- Table 2-3 Enclosure leakage current

TABLE 2-1 GROUND INTEGRITY

100 milliohms or less

TABLE 2-2 EARTH LEAKAGE CURRENT

AC Polarity	Line cord	Neutral cord	IEC 60601-1	UL 2601-1 ANSI/NFPA 99
Normal	Closed	Closed	500 μA	300 μA
Reversed	Closed	Closed	500 μA	300 μA
Normal	Open	Closed	1000 μA	500 μA
Normal	Closed	Open	1000 μA	500 μA

TABLE 2-3 ENCLOSURE LEAKAGE CURRENT

AC line cord polarity	AC line cord neutral conductor	AC line cord ground conductor	IEC 60601-1	UL 2601-1 ANSI/NFPA 99
Normal	Closed	Closed	100 µA	300 µA
Normal	Closed	Open	500 µA	300 µA
Normal	Open	Closed	100 µA	300 µA
Reversed	Closed	Open	500 µA	300 µA
Reversed	Open	Closed	500 µA	300 µA
Reversed	Closed	Open	500 µA	300 µA

2.3 Performance Verification

This section discusses the tests used to verify UUT performance

- Verifying general performance (Section 2.3.1)
- Checking the light intensity (Section 2.3.2)

All tests can be conducted without removing the UUT enclosure. If the UUT fails to conform or cannot be adjusted to conform, repairs must be made to correct the problem before the instrument is returned to the user.

TABLE 2-4 EQUIPMENT

Tools and test equipment	Type
Screwdriver	Phillips, medium
Photometer	Ohmeda BiliBlanket® Meter II or equivalent (see Note below)
Potentiometer adjustment tool	GC Electronics 8608 or small flat head screwdriver
Allen wrench	5/16″ 90 degree or equivalent
Safety glasses	Amber
Work pad	Any non-abrasive non-static surface

Note: If a different photometer is used please refer to the "Technical Note on Photometers" on page 55. If the meter is not listed in the conversion chart, please contact Natus Technical Service before adjusting the LED light panel intensity.

2.3.1 Verifying general performance

1. Turn off the Illuminated On/Standby switch and disconnect the AC power cord.
2. Remove the UUT from its roll stand by removing the four screws, seen in Figure 1-2 on page 11.
3. Place the UUT on the work pad so the diffuser/LED light panel can be examined. Verify that the air vents are not blocked.
4. Connect the AC power cord to the UUT and to an AC receptacle.

WARNING It is strongly recommended the amber safety glasses be worn at this time. Some people are affected by the blue color of the light source. The technician should notify others in the immediate area of this fact.

5. Place the light intensity rocker switch in the LOW position. Figure 1-1 on page 10 shows the location of the rocker switches.
6. Turn on the lighted On/Standby Switch.
7. Verify that the enclosure fan is running.

8 Confirm that the LED light panel lights are on and operating properly.

- Confirm the presence of both blue and yellow LEDs lighted in rows. Examine the light surface for 4 longitudinal bands connected with a transverse band at each end.
- Examine panel geometry for uniform light spacing and unlighted LEDs.

Note: The UUT can conform to specifications with some LEDs not lighted. However, if a large number of LEDs are not lighted it may prevent the UUT from meeting minimum values required during testing. If enough LEDs are missing the LED intensity adjustment may need to be adjusted higher than necessary, which would reduce panel life.

- Press the target light rocker switch and verify that a diamond shaped group of RED LEDs is lighted in the center of the LED light panel. The light must extinguish when the rocker switch is released.

9 Verify that the Illuminated On/standby switch lights up.

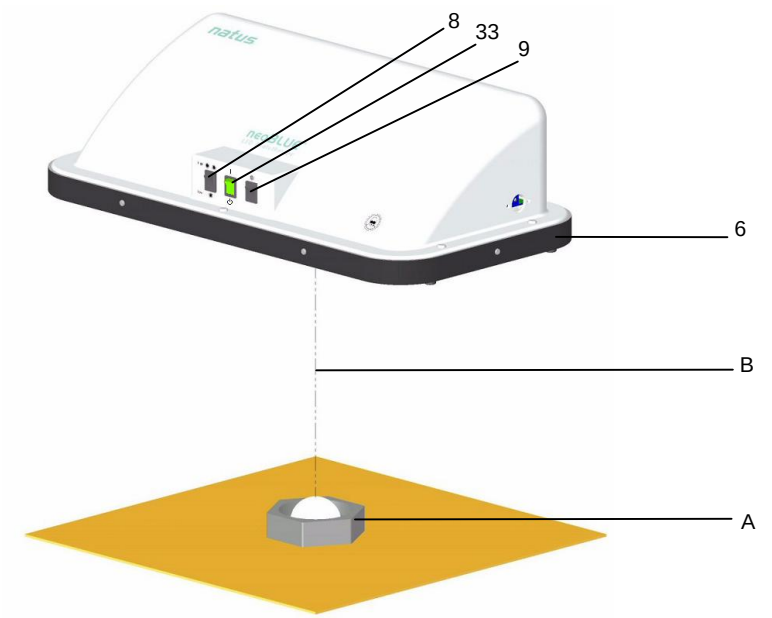
10 Verify the timer is operating. The decimal point should be flashing if the device is on and not flashing when the device is off. Turn off the UUT by turning off the Illuminated On/standby switch.

11 Check the light intensity. (Section 2.3.2 on page 22.)

2.3.2 Checking the light intensity

Important! Intensity measurements are based on the patient being 12" from the light panel diffuser of the UUT. Compensation may be included if the patient application distance is greater than 12". Adjusting the UUT light for a distance greater than 12" will decrease expected LED light panel life. Adjusting for a distance less than 12" will increase the LED light panel life. See UUT specifications (Section 5.6 on page 56 for expected LED light panel life on HIGH or LOW settings.)

FIGURE 2-2 MEASURING DISTANCE



Item	Description	Notes
6	Diffuser	Diffuses the light from the LEDs
8	Light intensity rocker switch	Sets intensity to high or low
9	Target light rocker switch	Controls red target light; momentary action
33	On/standby switch	Lights up when device is on
A	Photometer	
B	Distance	

1 Determine the distance (B) which corresponds to how far the LED light panel will be from the patient during therapy.

Important! The recommended distance (B) is 12”.

2 Position the stand to suspend the light panel over the work pad.

3 Place the photometer under the light panel. The distance (B) should be measured from the top of the photometer to the bottom of the diffuser (6) as shown in Figure 2-2.

4 Check the intensity on the HIGH setting:

- Place the light intensity rocker switch (8) in the HIGH position.
- Turn on the illuminated On/standby switch. Verify that the enclosure fan is running and that the LED light panel lights up.
- Power on the photometer and place it in the approximate center of the work surface below the UUT.
- After a stable reading is attained the photometer should be moved as necessary to establish a peak light reading. This should be in the approximate center of the area beneath the UUT diffuser.

Note: The Photometer must read 30-35μW/cm^2/nm. If the reading is not within the tolerance, note the value for use later in this procedure.

5 Check the intensity on the LOW setting:

- Place the light intensity rocker switch in the LOW position.
- Obtain a peak reading as in Step 4.

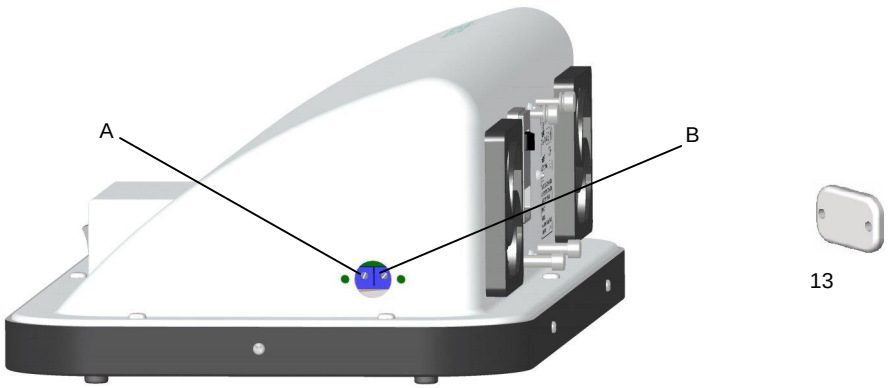
Note: The Photometer must read 12-15μW/cm^2/nm. If the reading is not within the tolerance, note the value for use later in this procedure.

6 If all criteria in the previous steps were met, the UUT performance has been verified and the UUT can be returned to the user. Turn off the UUT and ignore all further steps in this chapter.

7 If light intensity on either setting was not within tolerance, leave the test setup as is and proceed to Section 2.4 on page 25.

2.4 Adjusting light intensity

FIGURE 2-3 ADJUSTING THE POTENTIOMETERS



1 Place the light intensity rocker switch in the HIGH position.

- Examine the photometer reading.
- If necessary, remove the calibration access cover (13) and use the adjustment tool to adjust potentiometer A (in Figure 2-3) for a light intensity of 30-35 $\mu W/cm^2/nm$.

2 Place the light intensity rocker switch in the LOW position.

- Examine the photometer reading.
- If necessary, use the adjustment tool to adjust potentiometer B for a light intensity of 12-15$\mu W/cm^2/nm$.

3 If the tolerances in steps 4 and 5 in Section 2.3.2 are met, replace the calibration access cover. The UUT can be returned to the user.

Chapter 3 Troubleshooting Guide

In this chapter:

3.1	Troubleshooting the neoBLUE light	26
3.2	Troubleshooting the LED light current assembly	30

This chapter assumes that you are a qualified biomedical technician who is familiar with the neoBLUE light as described in Chapter 1.

3.1 Troubleshooting the neoBLUE light

Light does not appear when device is turned on	27
Illuminated on/standby switch doesn't light up	28
Light intensity will not adjust	28
Light intensity will not change between High and Low	28
Red target light does not come on	28
Diffuser has become excessively hot (above 50°C)	28
Patient becomes too warm	28
Enclosure fan not working (not audible)	29
Timer not updating/hours not displayed	29
Subplate fan not working	29
LED string(s) goes out	29
Multiple LED strings go out; cannot attain appropriate intensity	30

When opening the device, be sure to follow the procedures described in Chapter 5, as well as the steps and precautions in Section 2.2 on page 19 and Section 2.3 on page 20.

TABLE 3-1 TROUBLESHOOTING GUIDE

Symptom	Probable cause	Corrective Action	Reference
Light does not appear when device is turned on	No power	Verify that the AC outlet is functioning.	
	Power switch not in correct position	Ensure illuminated On/Standby switch is in ON (|) position	
	Power cord not plugged in all the way; or is defective	Check to make sure that power cord is plugged in all the way to the device socket. If the device will still not turn on try another power cord.	
	Blown fuses	Check the power entry module to make sure the fuses are intact.	Figure 1-2 on page 11
	If none of the above restores the light, open the device and check for the following:		
	Damaged cable	Perform end to end continuity checks on the cable going from the power supply to the LED light current assembly, the cable going from the LED light current assembly to the LED light panel, and the cable going from the LED light current assembly to the illuminated On/standby switch.	Figure 1-6 on page 15
	Damaged AC power entry module	Plug in. Verify that the voltage coming out of the power inlet is between 90-132V or 210-260V depending on the power system used in your country.	
	Damaged power supply	Verify that the power supply is putting out 23.8-24.2V.	
	Damaged LED light current assembly	Follow steps in "Troubleshooting the LED light current assembly."	Section 3.2 on page 30

Symptom	Probable cause	Corrective Action	Reference
Illuminated on/standby switch doesn't light up	Damaged casing	Perform continuity check on cable	
	LED switch burnt out	Replace switch	
	Damaged LED light current assembly	Follow steps in "Troubleshooting the LED light current assembly."	Section 3.2 on page 30
Light intensity will not adjust	Damaged LED light current assembly	Follow steps in "Troubleshooting the LED light current assembly."	Section 3.2 on page 30
	Maximum adjustment reached	Verify that that you have not reached the maximum trim position of the intensity adjustment potentiometer.	Figure 2-3 on page 25
		If you still cannot achieve the desired intensity, replace the LED light panel.	Section 4.2 on page 35
Light intensity will not change between High and Low	Broken switch	Open device and verify intensity switch continuity using a DVM	
	Damaged cabling	Perform an end to end continuity check on the intensity/target cable.	Figure 1-6 on page 15
	Damaged LED light current assembly	Follow steps in "Troubleshooting the LED light current assembly."	Section 3.2 on page 30
Red target light does not come on	Broken switch	Open device and verify intensity switch continuity using a DVM	
	Damaged cabling	Perform an end to end continuity check on the intensity/target cable.	Figure 1-6 on page 15
	Damaged LED light current assembly	Follow steps in "Troubleshooting the LED light current assembly."	Section 3.2 on page 30
Diffuser is excessively hot (above 50°C)	Subplate fan not working	If the diffuser surface is hotter than 50 degrees C, verify that both enclosure and subplate fans are functioning correctly. If they are not, refer to fan actions, below. Verify that vents are not blocked.	
Patient becomes too warm	Vents are blocked.	If the patient has become too warm, verify that vents are not blocked.	

Symptom	Probable cause	Corrective Action	Reference
	Subplate fan not working	Verify that both enclosure and subplate fans are functioning correctly. If they are not, refer to fan actions, below.	
Enclosure fan not working (not audible)	Fan jammed	Verify that nothing has become jammed in the fan.	Section 4.6.1 on page 42
	Fan cable not plugged in	Open the device and verify that the fan cable is plugged in securely.	Figure 1-6 on page 15
	Damaged cabling	Perform an end to end continuity check on the power/fan cable	Figure 1-6 on page 15
	No power	Verify with a DVM that there is 24-26.5V between pins 1 and 4 of J2.	Figure 1-5 on page 14
Timer not updating/hours not displayed	Damaged cabling	Perform end to end continuity check on timer power cable.	Figure 1-6 on page 15
	Damaged LED light current assembly	Follow steps in "Troubleshooting the LED light current assembly."	Section 3.2 on page 30
	Damaged timer	Replace timer.	
Subplate fan not working	Fan jammed	Open the device and verify that nothing has become jammed or broken in the fan. Open the device and verify that the fan blades have not separated from housing.	Figure 1-3 on page 12 Section 4.4.3 on page 39
	Damaged cable	Open the device and verify that the fan cable is plugged in securely.	Figure 1-6 on page 15
	No power	Verify that the red and blue wires are securely fastened to the plus and minus contacts on the power supply.	Figure 1-6 on page 15
LED string(s) goes out	LED short or open	You can increase the intensity if necessary. If the device still produces enough light there is no need to replace the panel.	Section 2.4 on page 25

Symptom	Probable cause	Corrective Action	Reference
Multiple LED strings go out; cannot attain appropriate intensity	Damaged LED light panel	Replace LED light panel	Section 4.2 on page 35

3.2 Troubleshooting the LED light current assembly

Before using this section please verify that you are getting the correct mains voltage out of the AC power entry module. Then verify that you are getting 23.5 to 24.5VDC out of the power supply.

Make sure that the device is turned on and that the cable coming from the power supply is plugged into the J2 header. Unplug the J1 header.

If any of the tests below fail, you have a damaged board and need to replace it.

1. Visually inspect for any burnt, broken, or shorted components.
2. Check for power (23.5 to 24.5VDC) at the following pin locations:
   - J1 pins 1,2,3
   - U1 pin 4
   - U2 pin 4
3. Ground at the following locations:
   - J1 pins 4,5,6
   - U1 pin 11
   - U2 pin 11
4. Check LED brightness voltages:

Function	Pins	Voltage range
Yellow LEDs	U2 pins 1,7	0.38-0.54 VDC

5 The voltages below should vary between the ranges given below when the adjustment potentiometers R3 (High) and R6 (Low) are turned. Turning clockwise should decrease the voltage. Conversely turning counterclockwise should increase the voltage.

Function	Pins	Voltage range
Blue LEDs	U1 pin 7	1.5-0.5 VDC (HIGH setting)
		0.85-0.17 VDC (LOW setting)

6 Illuminated switch voltages

Switch in On position	Pins	Voltage range
J4	pin 1	21.5V-24.5V
	pin 2	23.5V-24.5V
	pin 3	21.5V-22.5V
	pin 4	0V-0.1V
Switch in Off position	**Pins**	**Voltage range**
J4	pin 1	23.5V-24.5V
	pin 2	0-0.1V
	pin 3	0-0.1V
	pin 4	0-0.1V

7 Timer voltages

Illuminated switch in On position	Pins	Voltage range
J5	pin 1	23.5V-24.5V
	pin 3	0-0.1V
Illuminated switch in Off position	**Pins**	**Voltage range**
J5	pin 1	0-0.1V
	pin 3	0-0.1V

Chapter 4 Repair Procedures

In this chapter:

4.1	Removing the light diffuser	33
4.2	Removing the LED light panel	35
4.3	Removing the subplate	36
4.4	Removing components from the subplate	38
4.5	Replacing the subplate	40
4.6	Removing components from the enclosure	41

This chapter presents procedures for repairing the neoBLUE light, hereafter called the UUR (Unit Under Repair). Only qualified personnel should open the enclosure, remove and/or replace components or make adjustments. If your medical facility does not have qualified personnel, please contact Natus Technical Service for further assistance.

After any repair is completed and the UUR is reassembled, the technician must complete the safety tests and performance verification procedures listed in Section 2.2 on page 19 and Section 2.3 on page 20.

The UUR can be disassembled down to all major component parts.

TABLE 4-1 EQUIPMENT

Tool	Type
Screwdriver	Phillips, medium
Hex driver	1/16" deep socket
Wire cutters	Medium
Work pad	Any non-abrasive, non-static surface

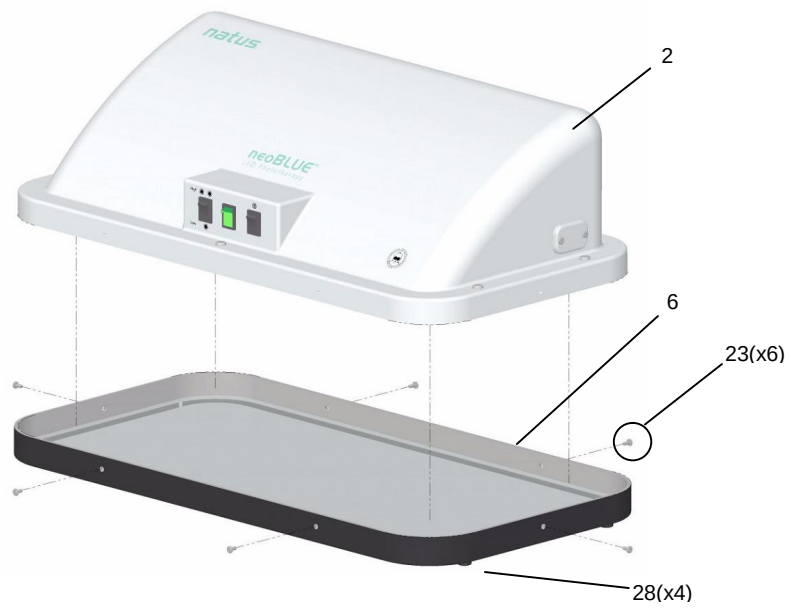
WARNING Disconnect the AC power cord before beginning disassembly as high voltages can be encountered during disassembly.

CAUTION: Approved anti-static measures must be used anytime the UUR is disassembled.

4.1 Removing the light diffuser

1. Detach the UUR from its roll stand.
2. Place the UUR upside-down on a suitable work pad.
3. Remove the six self tapping screws around the edge of the black frame of the diffuser (6).

FIGURE 4-1 REMOVING THE DIFFUSER



Item	Name
2	Enclosure
6	Diffuser
23	Self tapping screw, 3/8″
28	Rubber foot

4 Gently pull the diffuser away from the enclosure. Use caution. The diffuser assembly is tightly fitted on the enclosure.

5 If you are replacing the diffuser assembly, obtain the replacement and reverse the steps above to install the diffuser.

WARNING The diffuser must be screwed in securely. Failing to secure the diffuser could cause injury to the patient if the diffuser itself or any internal components were to become loose and fall during therapy.

6 If no further repair is required, return to Chapter 2 and perform tests for Safety (Section 2.2 on page 19) and Performance Verification (Section 2.3 on page 20).

7 If further disassembly is required, store the diffuser in a protected area and proceed to Removing the LED light panel.

4.2 Removing the LED light panel

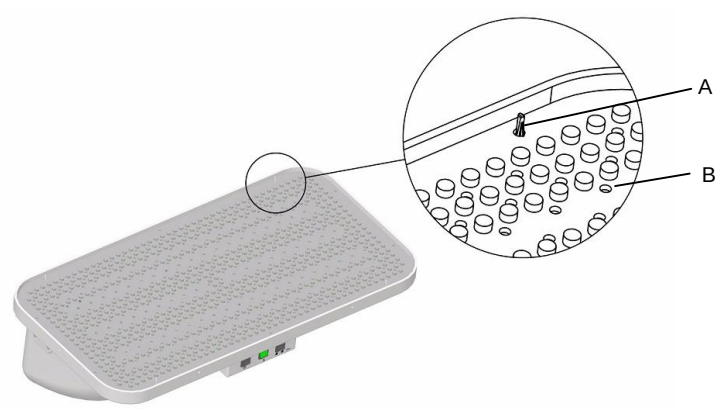
The diffuser must be removed (Removing the light diffuser on page 33) before beginning this procedure.

CAUTION: The LED light panel is a rigid large-scale printed circuit board and can be damaged if inordinate stress is applied during removal or replacement. Do not overly stress the board in its longitudinal plane during handling.

Note: There are six lock fasteners (A) around the periphery of the LED light panel and through-holes on the board.

1 Release a lock fastener (A) by depressing the protruding latch into the post body while pulling the board away.

FIGURE 4-2 REMOVING THE LED LIGHT PANEL



CAUTION: Do not use the LEDs to lift the board from the enclosure.

2 Use the needle-nose pliers to depress the fastener. Use the short length of the Allen wrench, under the board, to lift it slightly away from the clip. The Allen wrench can be used in one of the through-holes (B) or under the outside board edge.

3 Repeat the process until all six fasteners are released. Then carefully lift the edge of the board using the Allen wrench until the board can be removed from the subplate.

Note: The LED Plate is attached to the subplate by a power cable. Do not attempt complete removal until the cable connector is removed from the receptacle on the light panel. To remove the cable, squeeze the side flanges and pull up.

4 If you are replacing the light panel assembly, obtain the replacement and install the panel by reversing the steps above.

Note: Take care in routing the LED power cables away from and around the subplate fan when reassembling. The light panel must be oriented in the correct direction so that the the cable connector will line up correctly with the subplate opening.

5 If no further repair is required, reverse all previous steps in this procedure. Then return to Chapter 2 and perform safety and performance verification and adjustment.

6 If further disassembly is required store the LED light panel in a safe anti-static environment and proceed to Removing the subplate.

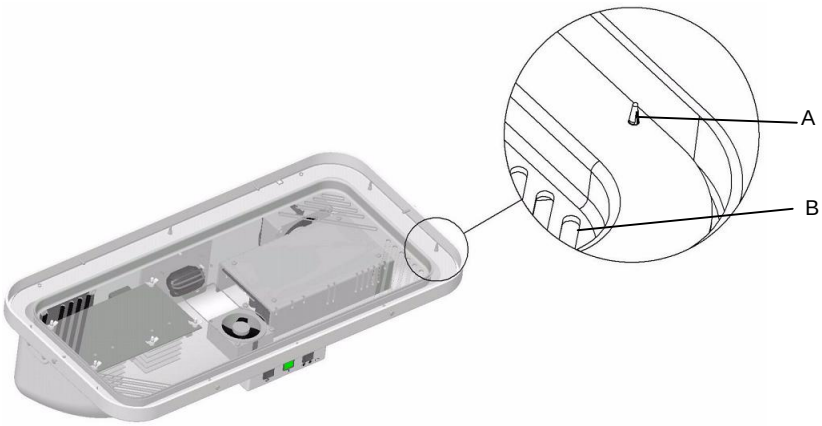
4.3 Removing the subplate

The LED light panel assembly must be removed (Section 4.1 on page 33) before beginning this procedure.

Note: There are six lock fasteners around the periphery of the subplate and many open slots on the subplate.

1 Release the lock fasteners by depressing the protruding latch into the post while gently pulling the subplate away from the enclosure.

FIGURE 4-3 DETACHING THE SUBPLATE



2 Use the needle-nose pliers to depress each latch (A). Use the short length of the Allen wrench to lift the subplate slightly away from the post. The short side of the Allen wrench can be used in one of the slots (B) or under the outside edge of the subplate.

3 Repeat the process until all six fasteners are released. Then carefully lift the edge of the plate using the allen wrench until the plate can be removed from the enclosure.

CAUTION: The subplate is attached to the enclosure by cables. The subplate can be partially removed without disconnecting the cables. Do not attempt complete removal until all cables are disconnected from either the subplate or the enclosure.

CAUTION: The enclosure fan cable is routed to prevent it having access to the top of the power supply assembly. Please maintain this routing when reconnecting the fan cable.

CAUTION: There are several heavy components mounted on the subplate. Avoid stressing the subplate or any particular component, thus preventing damage to the subplate.

Note: If the technician desires to troubleshoot the complete system at this time, skip the rest of this procedure, replace the LED light panel by reversing the steps in Removing the LED light panel on page 35. Then return to Chapter 3.

4 If you are replacing the subplate:

- First remove all components (Removing components from the subplate on page 38).
- Obtain the replacement part and reverse all component removal steps, then all previous disassembly steps until the UUR is completely assembled.
- Return to Chapter 2 and perform the safety tests and performance verification and adjustment if necessary.

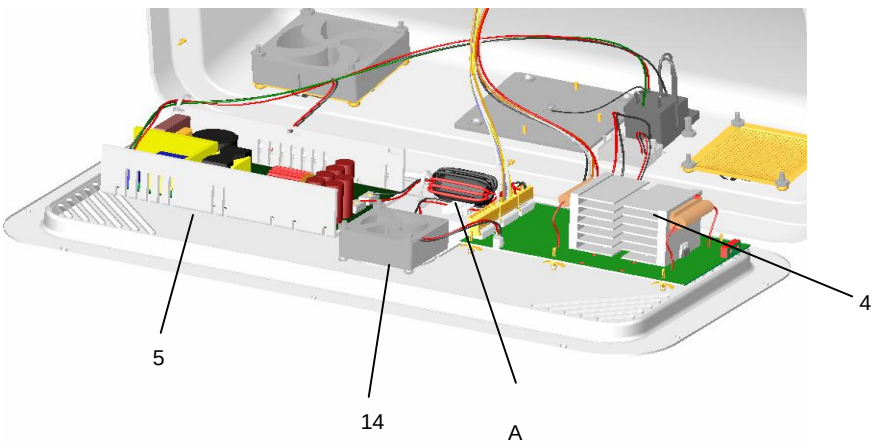
4.4 Removing components from the subplate

The subplate must be removed (Removing the subplate on page 36) before beginning these procedures. If one or more components requires replacement you may skip to the appropriate subsections. If replacing the subplate complete all steps.

Note: If only components on the enclosure require repair or replacement skip to Removing components from the enclosure on page 41.

- Removing the power supply assembly on page 39.
- Removing the LED light current assembly on page 39.
- Removing the subplate fan assembly on page 39.
- Removing the LED light panel cable on page 40.

FIGURE 4-4 SUBPLATE COMPONENTS



Item	Name
4	LED light current assembly
5	Power supply
14	Subplate fan
A	Hole for LED light panel cable (18)

Each component must be completely disconnected from any cabling before removal is attempted.

4.4.1 Removing the power supply assembly

1. Remove all connections to the power supply assembly observing orientation and cable color codes.
2. Use the Phillips screwdriver to remove the four screws securing the power supply assembly to the subplate. Remove the power supply assembly.
3. If you are replacing the power supply:
   - Obtain the replacement and reverse all of these steps to install.
   - Then reverse all steps in Section 4.3 on page 36 until the UUR is completely assembled.
   - Return to Chapter 2 and perform the safety tests and performance verification and adjustment.
4. If the subplate is being replaced continue to Removing the LED light current assembly.

4.4.2 Removing the LED light current assembly

1. Remove all connections to the LED light current assembly, observing placement and cable color codes.
2. The light current assembly is secured to the subplate by five retaining posts. Release the retainers using the needle-nose pliers to depress the retainer into the post. Gently pull the light current assembly away from the post. Repeat this step until the assembly is free. Remove the light current assembly.
3. If you are replacing the light current assembly:
   - Obtain the replacement and reverse all of these steps to install.
   - Reverse all steps in Section 4.3 on page 36 until the UUR is completely assembled.
   - Return to Chapter 2 and perform the safety tests and performance verification and adjustment.
4. If the subplate is being replaced continue to Removing the subplate fan assembly.

4.4.3 Removing the subplate fan assembly

1. Disconnect the cable that is connected to the current PCB header (J6).
2. Use the Phillips screw driver and 5/16 hex driver to remove the three screws securing the fan to the subplate.

   Note: The fan uses only 3 nuts although the plate has 4 holes.
3. Observing the fan orientation indicated by the printed arrow, remove the fan.

4 If the fan is being replaced:

- Obtain the new fan and reverse the steps in this procedure to install.

CAUTION: Take care in routing wires so as to avoid potential jamming of the fan.

- Reverse all steps in Section 4.3 on page 36 until the UUR is completely assembled.
- Return to Chapter 2 and perform the safety tests and performance verification and adjustment.

5 If the subplate is being replaced continue to Removing the LED light panel cable.

4.4.4 Removing the LED light panel cable

1 Disconnect all cable connectors from their receptacles observing orientation and cable colors.

2 Use the wire cutters to remove the two tie-wraps securing the cable to the subplate and remove the the cable.

3 If you are replacing the cable (part #18):

- Obtain the replacement and reverse the steps in this section (4.4) to install.
- Reverse all steps in Section 4.3 on page 36 until the UUR is completely assembled.
- Return to Chapter 2 and perform the safety tests and performance verification and adjustment.

4.5 Replacing the subplate

The subplate components must be removed (Removing components from the subplate on page 38) before replacing the subplate.

1 Obtain the replacement and reverse all steps in Removing components from the subplate to reinstall major components.

2 Reverse all steps in Section 4.3 on page 36 until the UUR is completely assembled.

3 Return to Chapter 2 and perform the safety tests and performance verification and adjustment.

4.6 Removing components from the enclosure

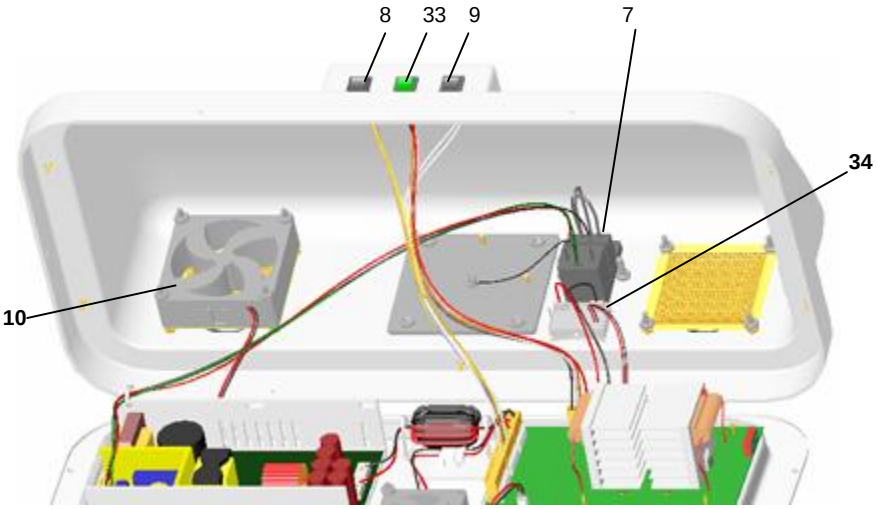
Before removing components from the enclosure, disassemble the UUR by following the procedures in Sections 4.1 on page 33 through 4.3 on page 36. The following sections discuss removal of the enclosure components, which are shown in Figure 4-5 on page 42.

- Removing the enclosure fan on page 42
- Removing the AC power entry module on page 43
- Removing the switches on page 43
- Removing the timer on page 44

TABLE 4-2 EQUIPMENT

Tools required	Type
Screwdriver	Phillips, medium
Hex driver	5/16" deep socket
Hex driver	1/4" deep socket

FIGURE 4-5 ENCLOSURE COMPONENTS



Item	Name
7	Power entry module
8	light intensity rocker switch
9	Target rocker switch
10	Enclosure fan
33	Illuminated switch
34	Timer

4.6.1 Removing the enclosure fan

1 The enclosure fan is connected to the subplate wire harness by a cable. Disconnect the cable from the wiring harness.

Note: The enclosure fan cable is routed to prevent it from having access to the top of the power supply assembly. Please maintain this routing when replacing the fan cable.

2 Remove the filter assembly on the back of the enclosure.

3 Use the Phillips screw driver and the 1/4" hex driver to remove the four screws securing the fan to the enclosure. Remove the fan, observing the orientation as indicated by the printed arrow.

4 If the fan is being replaced:

- Obtain the replacement and reverse these steps to install.
- Reverse all steps in Section 4.3 on page 36 until the UUR is completely assembled.
- Return to Chapter 2 and perform the safety tests and performance verification and adjustment.

4.6.2 Removing the AC power entry module

1 Observing location and connector orientation, disconnect the AC power entry module power cable to the power supply assembly.

2 Remove the AC power entry module grounding cable to the mounting plate.

3 Remove the two screws securing the AC power entry module from the enclosure and remove the module.

4 If the AC power entry module is being replaced:

- Obtain the replacement and reverse these steps to install.
- Reverse all steps in Section 4.3 on page 36 until the UUR is completely assembled.
- Return to Chapter 2 and perform the safety tests and performance verification and adjustment.

Important! Ensure that the ground wire to plate is attached after either disassembling or re-assembling the UUR.

4.6.3 Removing the switches

1 Disconnect the spade connectors from the switch to be removed. Take note of wire colors and connections.

2 Remove the switch by compressing the spring fasteners on either side of the switch housing. The switch can be pushed out the rear of the enclosure.

3 If a switch is being replaced:

- Obtain the replacement and reverse these steps to install.
- Reverse all steps in Section 4.3 on page 36 until the UUR is completely assembled.
- Return to Chapter 2 and perform the safety tests and performance verification and adjustment.

4.6.4 Removing the timer

1. Press the side tabs of the plastic clamp, holding the timer in, and pull back to free it from the timer.
2. Disconnect the spade connectors from the timer.
3. Disconnect the cable from the J7 header on the current PCB.
4. If the timer is being replaced:
   - Obtain the replacement and reverse these steps to install.
   - Return to Chapter 2 and perform the safety tests and performance verification and adjustment.
   - Reverse all steps in Section 4.3 on page 36 until the UUR is completely assembled.

Chapter 5 Parts and Specifications

In this chapter:

5.1	How to order parts	45
5.2	Parts in context	45
5.3	Parts list	48
5.4	Illustrations of major parts	52
5.5	Accessory pack	54
5.6	Specifications	56

5.1 How to order parts

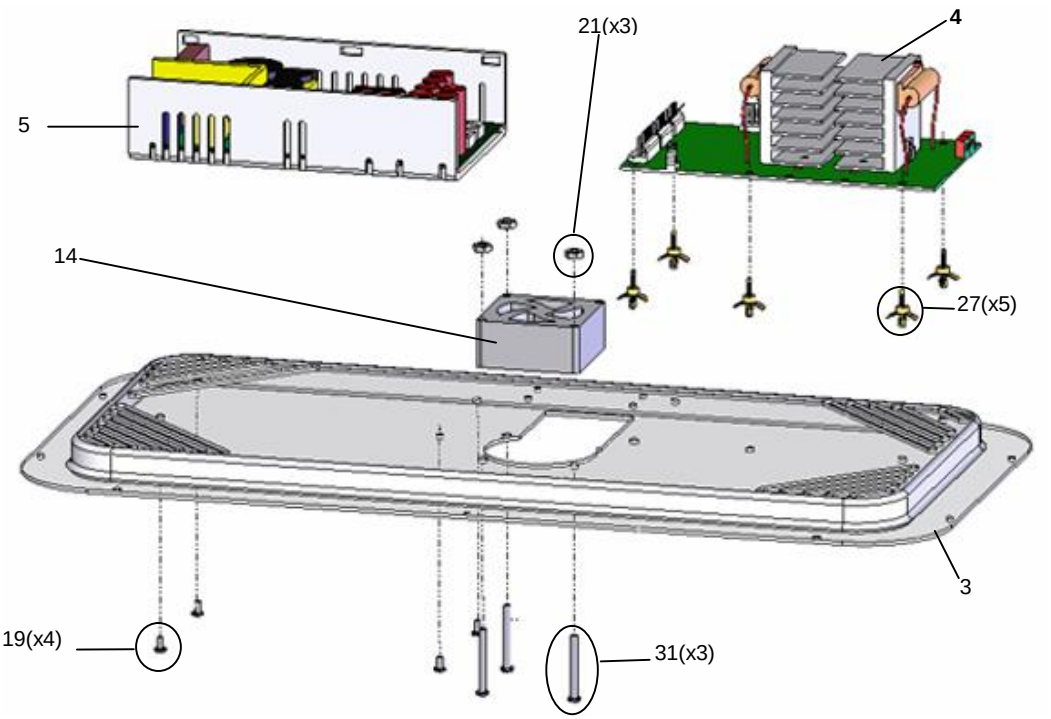
Call Technical Service at 1-888-496-2887 to order parts or for general technical information. A minimum order may be required for spare parts. The list of product specifications in this chapter will guide you in making purchases from vendors other than Natus.

5.2 Parts in context

Two views of the neoBLUE light appear below, to show you where the parts are and how they fit together. The views are:

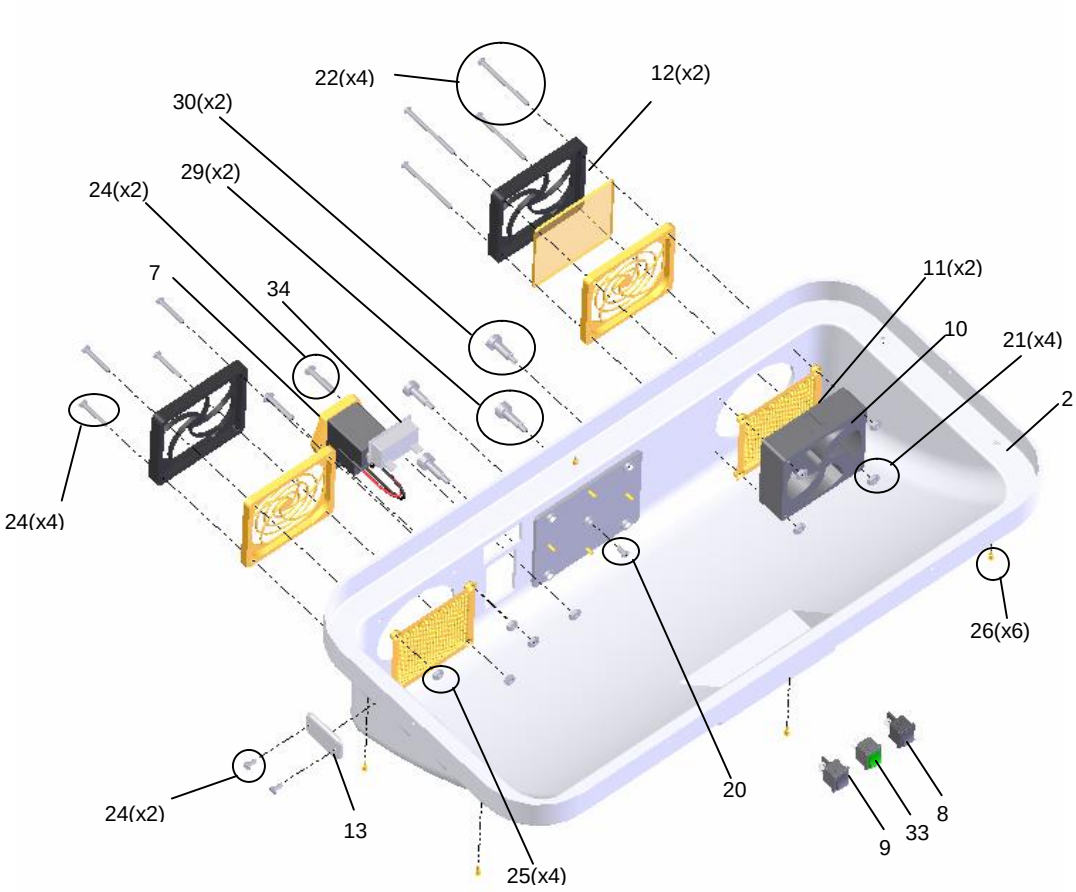
- **Subplate and its attachments.** The subplate holds the power supply, subplate fan, and LED light current assembly.
- **Enclosure and its attachments:** The enclosure holds the enclosure fan and vent, the switches, AC power entry module, and the access cover to the calibration poteniometers. It is mounted to the roll stand.

FIGURE 5-1 SUBPLATE AND ITS ATTACHMENTS



Item	Description	Item	Description
3	Subplate	19	Screw 1/4″
4	LED light current assembly	21	Nut 5/16″
5	Power supply	27	Nylon board lock fasteners
14	Subplate fan	31	Screw 1 1/4″

FIGURE 5-2 ENCLOSURE AND ITS ATTACHMENTS



Item	Description	Item	Description
2	Enclosure	21	Nut, 5/16″
7	AC power entry module	22	Screw, 1 3/4″
8	Light intensity switch	24	Screw, 5/8″
9	Target rocker switch	25	Nut
10	Fan, external	26	Reverse lock fastener

(continued on next page)

Item	Description	Item	Description
		(continued from previous page; see Figure 5-2)	
11	Vent guard	29	Thumbscrew
12	Enclosure fan filter assembly	30	Locating post screw
13	Calibration access cover	33	Illuminated on/standby switch
20	Screw, 1/4"	34	Timer

5.3 Parts list

The parts list numbering system is used to refer to parts throughout this manual.

The column headings in the parts list table are:

Item # Number used to refer to the part in this manual

Qty Quantity of this part used in the neoBLUE light

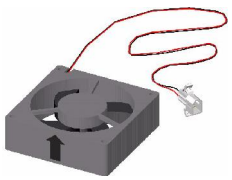
Part # Natus part number, for ordering the part

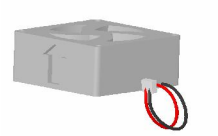
Name Name of the part, sometimes with descriptive notes

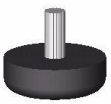
Illustration Picture of the part, or reference to a figure

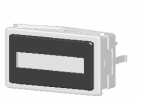
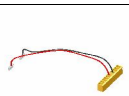
TABLE 5-1 PARTS LIST FOR NATUS NEOBLUE SYSTEM

Item#	Qty	Part #	Name	Illustration
1	1	030717	LED light panel	Figure 5-3 on page 52
2	1	040775	Enclosure	Figure 5-4 on page 53
3	1	030703	Subplate	Figure 5-5 on page 53
4	1	040891	LED light current assembly	Figure 5-6 on page 54
5	1	600133	Power supply	Figure 1-4 on page 13
6	1	030718	Diffuser	Figure 4-1 on page 34

Item#	Qty	Part #	Name	Illustration
7	1	040905	AC power entry module	
8	1	600122	Rocker switch, light intensity	
9	1	600123	Rocker switch, target light	
10	1	040772	Fan, enclosure	
11	2	600131	Vent guard	
12	2	600126	Enclosure fan filter assembly	
13	1	030646	Calibration access cover	

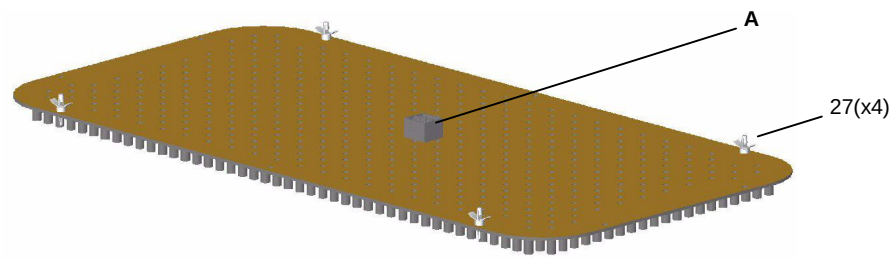
Item#	Qty	Part #	Name	Illustration
14	1	040908	Fan, subplate	
15	1	030816	Cable, Intensity/target 5 conductor cable w/ 1 connector and 5 spade connectors.	n/a
16	1	030817	Cable, Fan/power supply 4 Conductor cable w/2 connectors and 2 lug rings	n/a
17	2	900143	Cable Tie, 6" Nylon	n/a
18	1	030818	Cable, LED light panel 6 Conductor cable w/ 2 connectors	n/a
19	4	800004	Screw, 6-32x 1/4”	
20	1	800101	Screw, 8-32x1/4”	
21	7	800159	Nut, 6-32x 5/16”	
22	4	800200	Screw, 6-32x 1 3/4”	
23	6	800185	Screw, Self tapping, 6-20x 3/8”	
24	8	800043	Screw, 4-40x5/8”	

Item#	Qty	Part #	Name	Illustration
25	6	800008	Nut, 4-40	
26	6	800221	Fastener, Reverse lock	
27	9	800228	Fastener, Nylon board lock	
28	4	800230	Rubber foot, attached to diffuser	
29	2	800226	Thumbscrew, 8-32	
30	2	800227	Screw, Locating post	
31	3	800050	Screw, 6-32x1 1/4”	
32	1	040757	Accessory pack	Section 5.5 on page 54.
33	1	600167	Switch, Illuminated, Green	

34	1	900831	Timer, single display	
35	1	040892	Cable, Power for timer, 2 conductors with 1 connector and 2 spade connectors	
36	1	040894	Cable, On/standby switch, 4 conductors with 1 connector and 4 spade connectors	

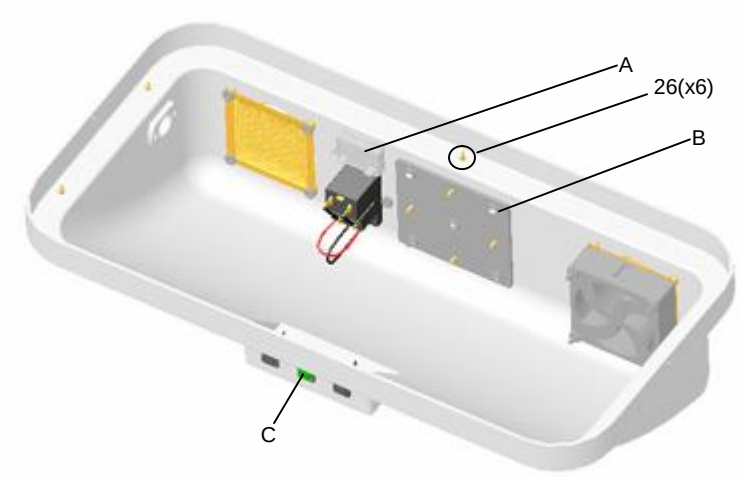
5.4 Illustrations of major parts

FIGURE 5-3 LED LIGHT PANEL (ITEM #1)



A	Connector for LED cable
27	Nylon board lock fastener

FIGURE 5-4 ENCLOSURE (ITEM #2)



A	Timer hole
B	Roll stand mounting plate
C	Illuminated switch hole
26	Reverse lock fastener

FIGURE 5-5 SUBPLATE (ITEM #3)

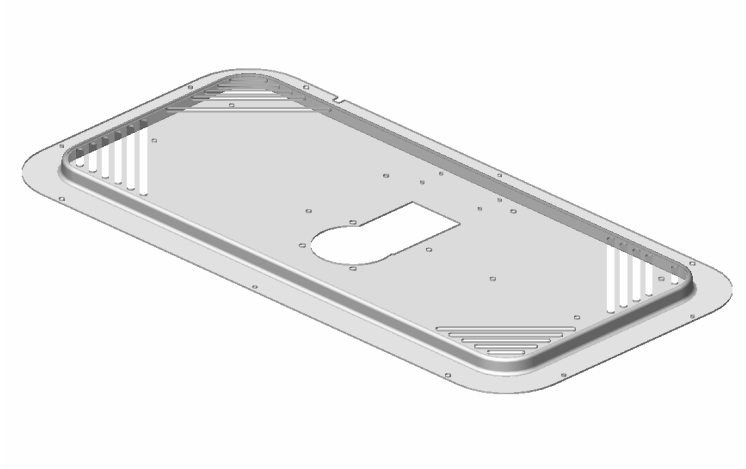
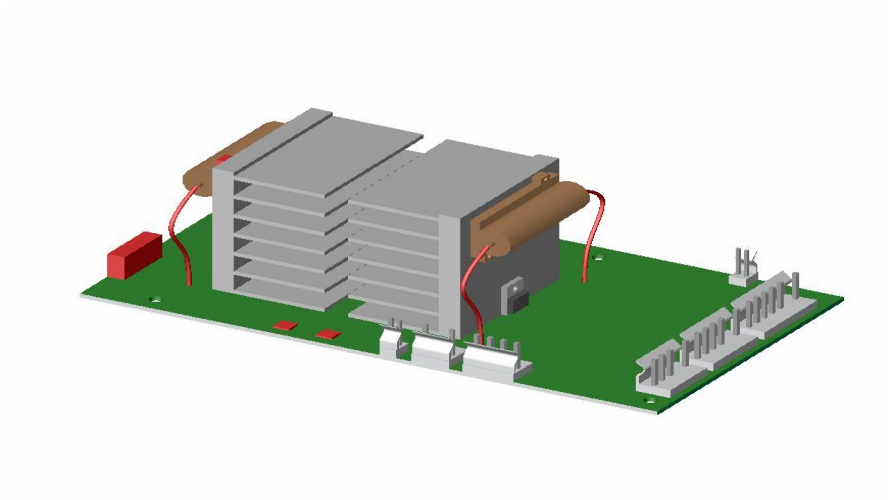


FIGURE 5-6 LED LIGHT CURRENT ASSEMBLY (ITEM #4)



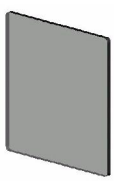
5.5 Accessory pack

The accessory pack included with your neoBLUE light includes spare parts and information. Its contents are listed in Table 5-2. The CD Rom in the accessory pack contains the following files:

- PDF files for the User Manual and this Service Manual. These manuals may be used online or printed out. For best results, print two-sided, in color.
- Warranty statement

TABLE 5-2 ACCESSORY PACK

Item#	Qty	Name	Illustration
	1	User Manual, English, printed	n/a
	1	Technical Note (laminated)	n/a
	1	CD Rom	n/a
	1	Power Cord, Hospital Grade	n/a

Item#	Qty	Name	Illustration
	1	Power cord strain relief	
29	2	Thumbscrew, 8-32	
30	2	Screw, Locating post	
	1	Enclosure filter set, 5 filters	

5.6 Specifications

Light Source	Blue and Yellow LEDs
Wavelength	Blue: Peak between 450 and 475 nm Yellow: Peak between 585 and 595 nm
Intensity Low setting High setting	Average central intensity at 12 in (30 cm) 12-15 μW/cm²/nm 30-35 μW/cm²/nm
Variation in intensity over 6 hrs	± 10% (within illumination area)
Effective surface area	20 x 10 in (50 x 25 cm)
Intensity ratio	> 0.4 (minimum to maximum)
Heat output at 11.8 in (30 cm) over 6 hrs	< 50° F (10° C) warmer than ambient
Electrical Mains	85–264 VAC, 47 to 63 Hz
Maximum Rating	3A, 100-240V~, 50/60 Hz
Fuses	4A @ 100-120V~, 50/60 Hz 2A @ 200-240V~, 50/60 Hz
Safety	
Leakage current	< 100 μA
Audible Noise	<60 dB
Dimensions	
Maximum Height	< 6 ft (1.83 m)
Weight	< 8.0 lbs (3.6 kg) (light enclosure only) < 40 lbs (18 kg) (with roll stand)
Environmental	
Operating Temperature/Humidity	59° F to 95° F (15 to 35° C) / 0% to 90% non condensing
Storage Temperature/Humidity	-22° F to 122° F (-30 to 50° C) / 0% to 90% non condensing

Roll Stand

Height of diffuser from ground	adjustable from 42 to 59 ± 3 inches (1.07 m to 1.50 m ± 7.5 cm)
Center of diffuser from post	adjustable from less than 9 to 13 ± 1 inches (23 cm to 33 cm ± 2.5 cm)
Tilt adjustment of enclosure	0º (horizontal) to approx. 40º
Clearance of base from floor	<4 inches (10 cm)
Base	5 legs with casters (2 locking casters)

Timer

Records	99999.9 hours
Run indicator	Blinking decimal point
Quartz accuracy	0.02% over entire voltage and temperature

Regulatory Standards	Type BF EN 60601-1-1, EN60601-1-2 EN60601-2-50 UL2601-1 CSA C22.2 606.1

Chapter 6 Technical Note on Photometers

Note: This information is also delivered in the accessory pack, laminated so that it can be kept with the device for convenient reference.

This technical notice provides important information about using photometers to measure the light intensity output of the neoBLUE™ LED Phototherapy device.

Natus recommends that the neoBLUE light intensity output be checked with a photometer before each use, and at least every six months. In addition, your photometer should be calibrated according to the manufacturer's specifications (typically on an annual basis).

The light intensity output of the neoBLUE device is measured at Natus (prior to shipment) with the Ohmeda BiliBlanket® Meter II. Because your facility may use a different photometer to measure the light intensity output, it is necessary to understand how your reading correlates to the Ohmeda reading.

The following table provides a light intensity output conversion chart, when measured at 12 inches (30.5 cm) from the center of the neoBLUE light enclosure.

TABLE 6-1 NEOBLUE LIGHT INTENSITY OUTPUT CONVERSION CHART

Photometer	Ohmeda Bili-blanket® Meter II*	Joey® Dosimeter Model JD100	Olympic® Bili-Meter®
Reading at 12 inches (30.5 cm) ($\mu W/cm^2/nm$)	35	90.6	20.6
	30	77.6	17.6
	25	64.5	14.2
	20	51.2	10.9
	15	38	7.8
	10	25.5	4.9
Reading tolerance	+/- 3%	+/- 2%	+/- 1.9%

* This photometer is used for measuring the neoBLUE light intensity output prior to shipment.

If necessary, please call Natus Medical Technical Service at +1 650.802.0400 or your authorized service representative.

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